

Outcomes of a NASA Workshop to Develop a Portfolio of Low Latency Datasets for Time-Sensitive Applications



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Workshop Charge

- Develop a written (living) inventory of ***existing and planned/budgeted*** NASA/ESD Near-Real-Time data sets, information products, and associated discovery/distribution infrastructure
- Identify any ***significant*** populations of ***supporters*** and/or ***potential benefits*** from our ***existing*** measurements and data sets, that ***are not being fulfilled*** because NASA/ESD products are being made available with too much delay

Definitions *.....for the purpose of this presentation*

Low latency, or Near real-time (NRT), data are made available much faster than routine processing allows.

Data latency refers to the time between data acquisition and the time the data is available to the end-user.

Defining latency?

0-1 hour = Real-time

< 3 hours = Near real-time

3 – 24 hours = Low latency?

➤ 24 hours but quicker than routine = expedited?



Meeting Overview

2.5 day meeting 104 Participants

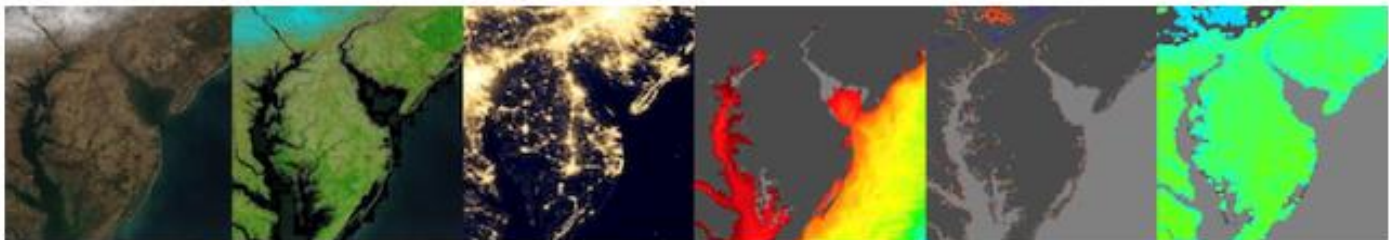
Plenary sessions

- NASA Headquarters
- Existing systems for providing NRT data
- Selected data providers and users

Breakout Groups

- Completing the Inventory
- Identifying opportunities and gaps in the provision and delivery of NRT data

75	NASA
11	Universities
11	Other US government
4	Private Sector
3	Non-Government



NASA HQ Perspective: “Low-Latency” Principles in Earth Science Division Portfolio Development

- NASA Earth Science Division (ESD) endeavors to provide low-latency data and products when it involves small additional costs
- NASA ESD is primarily a science organization and science and non-real-time research objectives will ***outweigh*** support for near-real-time users when they are in direct conflict.

NASA Mission perspective on support for NRT data production

- If NRT considerations should be part of the project trade space then cost/benefit should be considered when the project is in it's embryotic stage
- After design starts don't expect changes in latency design
- Latency can be improved during operations, but a non-project funding source will need to be identified.



Inventory

Develop a written “living” inventory of existing and planned/budgeted NASA/ESD Near-Real-Time data sets, information products, associated discovery and distribution infrastructure.

Existing Missions	Instrument	Number of products	Latency Term	Latency Range
Aqua	CERES	5	Expedited	4-5 days
Aqua	MODIS	26	NRT	<3 hrs
Aqua	AIRS	8	NRT	<3 hrs
Aura	OMI	5	NRT	<3 hrs
Aura	MLS	7	NRT	<3 hrs
CALIPSO	CALIOP	5	Expedited	6-30 hrs
GCOM-W1	AMSR2	8	NRT	<3 hrs
GPM	GMI/Multiple	12	NRT-Expedited	1 hr - 16 hrs
GRACE	Multiple	1	Expedited	monthly
S-NPP	ATMS	2	NRT	<3 hrs
S-NPP	CERES	5	Expedited	4-6 days
S-NPP	VIIRS	20	NRT	<3 hrs
S-NPP	OMPS	4	NRT	<3 hrs
Terra	ASTER	2	Low Latency	<24 hrs
Terra	CERES	5	Expedited	4-6 days
Terra	MODIS	33	NRT	<3 hrs
Terra	MOPPIT*	1	NRT	<3 hrs
Terra	MISR	3	NRT	<3 hrs
JASON-2, 3	Poseidon-3, 3b	1	Expedited	<24 hrs
Landsat 7	ETM+	1	Low Latency	4-8 hrs
Landsat 8	OLI/TIRS	1	Low Latency	4-8 hrs
SMAP	L-band Passive	2	Low Latency	4-7 hrs
ISS Missions	CATS	4	Low Latency	4-7 hrs
ISS Missions	LIS*	2	Real time	<30 min
ISS Missions	HDEV	1	Real time	<30 min
ISS Missions	Crew Observations	1	Expedited	24+ hrs
Geostationary	AHI GOES	6	Real time	5-30 min
GMAO Models	GOES 5 processing	1	NRT	6 hrs
TOTAL		173		

Inventory: <http://tinyurl.com/nhmv9ky>

Mission	Instrument	Description	SHORT NAME NAME	DATA PROVIDER	LATENCY	Drought	Agriculture	Snow/Ice moni	ocean / lake c	disturbance d	Wildland fire	Smoke Flu	
ONGOING MISSIONS													
Dawn	CERES	Surface and Cloud Properties (SSF)	FLASH_SSF_Aqua	CERES/ASDC	4-5 days		X						
		TOA surface fluxes and clouds (SSF)	FLASH_SSF_Aqua	CERES/ASDC	4-5 days	X	X						
		TOA and Surface radiative flux averages (daily aver	FLASH_TISA (Terra+Aqua)	CERES/ASDC	5-6 days	X	X						
		Synoptic radiative fluxes	FLASH_TISA (Terra+Aqua)	CERES/ASDC	5-6 days	X	X						
		Synoptic cloud and water vapor	FLASH_TISA (Terra+Aqua)	CERES/ASDC	5-6 days		X						
Aqua	MODIS	Raw radiances	MYD01	LANCE-MODIS	<3 hours			X					
		Geolocation	MYD03	LANCE-MODIS	<3 hours			X			X		
		Calibrated radiances	MYD21KM/HKM/QKM	LANCE-MODIS	<3 hours	X	X				X		
		Aerosols	MYD04_L2	LANCE-MODIS	<3 hours							X	X
		Total Precipitable Water Vapor	MYD05_L2	LANCE-MODIS	<3 hours								
		Cloud Product	MYD06_L2	LANCE-MODIS	<3 hours				X	X			
		Temperature and Water Vapor Profiles	MYD07_L2	LANCE-MODIS	<3 hours	X	X						
		Land Surface Reflectance	MYD09	LANCE-MODIS	<3 hours	X	X					X	X
		Land Surface Reflectance, coarse	MYD09CRS	LANCE-MODIS	<3 hours								
		Aerosol optical thickness	MYD09CMA	LANCE-MODIS		X	X						
		Surface reflectance, climate modeling grid	MYD09CMG	LANCE-MODIS									
		Surface reflectance, L2G Lite	MYD09GA	LANCE-MODIS		X	X					X	
		Daily Surface reflectance, L2G Lite	MOD09GST	LANCE-MODIS									
		Snow Cover	MYD10_L2	LANCE-MODIS	<3 hours	X	X		X				
		Surface Temperature and emissivity	MYD11_L2	LANCE-MODIS	<3 hours	X	X					X	
		Thermal Anomalies / Fire	MYD14	LANCE-MODIS	<3 hours		X					X	X
		Thermal Anomalies / Fire text for FIRMS	MYD14T	LANCE-MODIS - FIRMS	<3 hours		X						X
		Sea ice extent	MYD29	LANCE-MODIS	<3 hours				X			X	
		Cloud mask	MYD35_L2	LANCE-MODIS	<3 hours	X	X		X	X	X		
		Value added Aerosol Optical Depth	MYDAODHD	LANCE-MODIS									X
		Daytime geolocation angles	MYDMGGAD	LANCE-MODIS									
		Daytime pointers	MYDPTHKM	LANCE-MODIS									
		Daytime thermal bands	MYDTBGD	LANCE-MODIS				X				X	
		Corrected reflectance imagery		LANCE-MODIS									X
		Rolling BRDF / Albedo / NBAR*		LANCE-MODIS				X					
		Volcano alert	MYDVOLC	LANCE-MODIS									
		Rolling 8-day surface Reflectance	MYD09AIN	LANCE-MODIS		X	X						
		Sea Surface Temperature	MODISA_L2_SST	OB DAAC	2-4 hours				X	X	X		
		Ocean Color Data	MODISA_L2_OC	OB DAAC	2-4 hours					X			
		Ocean inherent optical properties	MODISA_L2_IOP	OB DAAC	2-4 hours					X			
		NDVI						X	X				
		LAI*						X	X				
		Green Veg Fraction						X	X				
		In-flight icing detection				NASA SatCORPS	< 40 min						

Discoverability and Usability

- Inventory is one step to increasing access to NRT datasets but Discoverability and Usability are critical.
 - Discoverability includes ways in which the community can determine which data are available and where they can be obtained.
 - Usability is the ability to easily visualize or integrate the data into analysis tools to facilitate data use
- EOSDIS already has services that can help users discover and visualize data. These include:
 - Common Metadata Repository (CMR)
 - Global Imagery Browse Services (GIBS)
 - Earthdata Search Client
 - Worldview

Common Metadata Repository (CMR)

- What does it do?
 - It manages the **metadata catalog** for NASA's Earth observations + includes some external collection info
- What does it contain?
 - **Collection** info (e.g., "MODIS/Aqua Near Real Time (NRT) Aerosol 5-Min L2 Swath 10km")
 - **Granule** info (e.g., "BeginningDateTime: 2016-09-26T01:20:00.000000Z")
 - **Parameter** info
 - Etc.

CMR metadata supports various standards (such as such as ISO 19115-1, ISO 19115-2, ECHO 10, DIF 9, or DIF 10) and supports OpenSearch compliant queries enabling by other search clients.

Global Imagery Browse Services (GIBS)

- Visualization

- The Global Imagery Browse Services (GIBS) provides full-resolution imagery via web services for 200+ EOSDIS collections (a fraction of the total)
- The Worldview client provides an interface for all GIBS products and will continue to categorize its layers into NRT application areas



GIBS Integrations

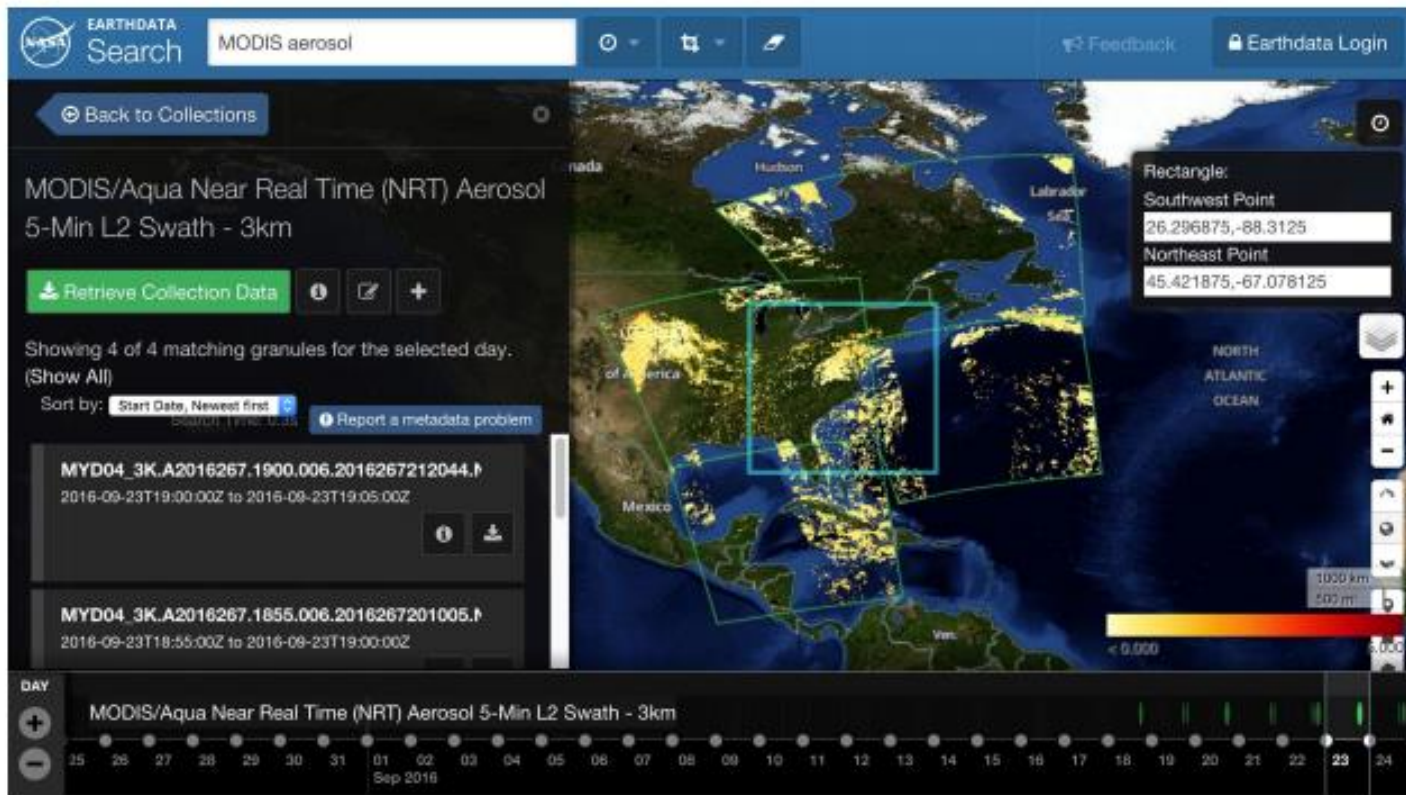
Earthdata Search

Image representations of data granules served by GIBS can be viewed on a map in the Earthdata Search client (<https://search.earthdata.nasa.gov/>).

The screenshot displays the Earthdata Search web application interface. At the top, the 'EARTHDATA' logo is on the left, followed by a search bar containing 'land surface temperature'. To the right of the search bar are a 'Temporal' dropdown menu, a warning icon, a 'Feedback' link, and an 'Earthdata Login' button. Below the search bar is a 'Back to Dataset Search' button. The main content area is divided into two sections. On the left, under 'Project Datasets', there is a 'Retrieve Project Data' button and a dataset preview card for 'MODIS/Aqua Land Surface Temperature/Emissivity 5-Min L2 Swath 1km V005' with a thumbnail image and a date of '2002-05-04'. On the right, a large map shows the land surface temperature data overlaid on a satellite-style map of the Middle East and surrounding regions. The data is color-coded, with warmer temperatures in red and yellow, and cooler temperatures in green and blue. A scale bar at the bottom right of the map indicates 1000 km and 500 m. At the bottom of the interface, a 'YEAR' timeline shows the years from 2006 to 2014, with a green bar indicating the current data range. The footer contains the version 'v 1.3.1', NASA contact information, and a link to the Earthdata Access Section 508 accessible alternative.

● Search and Order

- The Common Metadata Repository (CMR) is a database for **ALL** collections (over 30k) available through EOSDIS
- The Earthdata Search client provides a window into all collections in CMR



Existing Approach <https://search.earthdata.nasa.gov/>

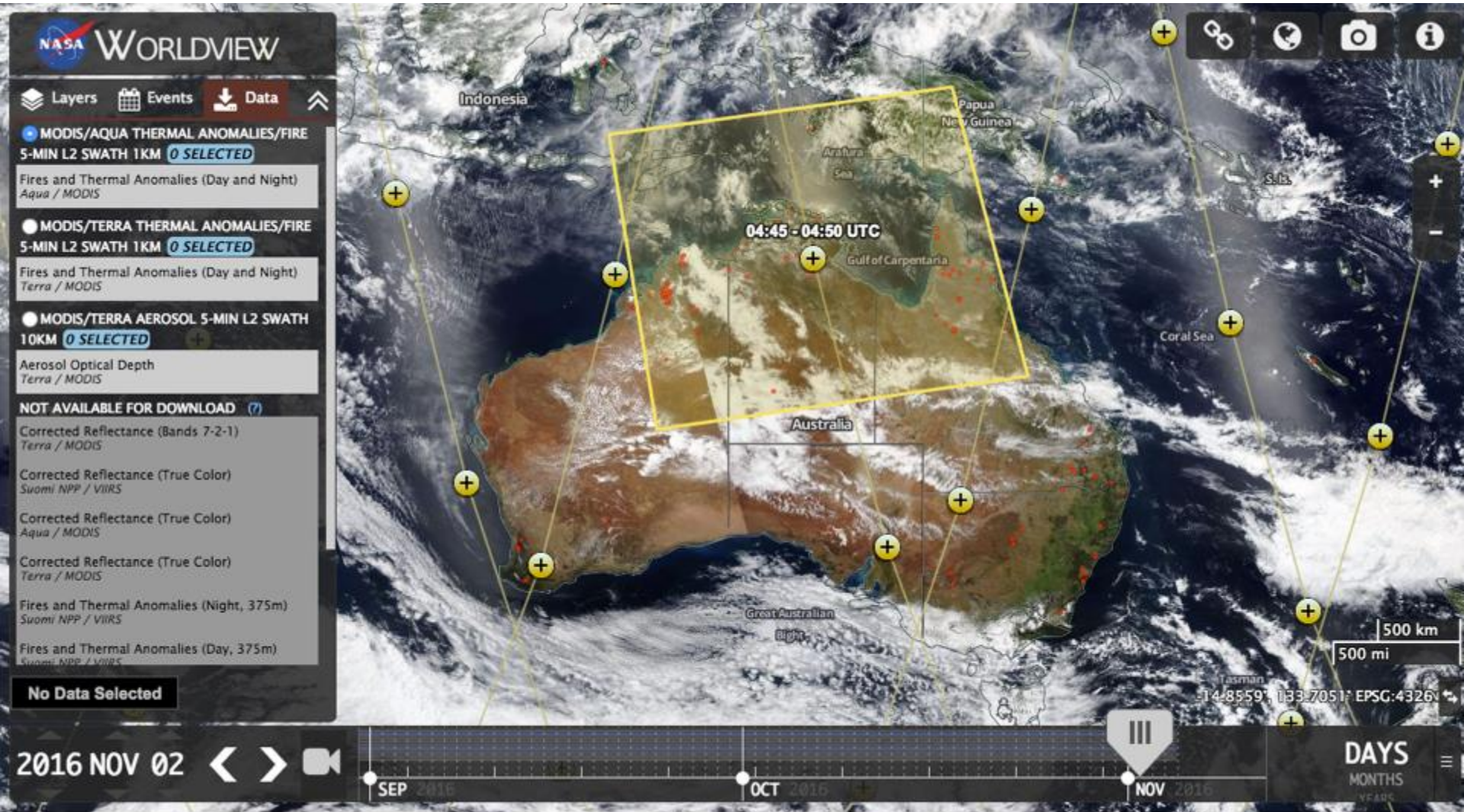
The screenshot displays the NASA Earthdata Search interface. At the top, the NASA logo and 'EARTHDATA Search' are visible, along with a search bar containing the text 'Type any topic or collectio'. Navigation icons for home, search, and help are present. On the right, there are links for 'Feedback' and 'Earthdata Login'.

The main content area is titled 'Browse Collections' and shows '169 Matching Collections'. A sidebar on the left lists various features, with 'Near Real Time' highlighted in green. A large black arrow points to the 'Near Real Time' filter. Below the sidebar, there are sections for 'Subsetting Services', 'Keywords', and a list of categories: Atmosphere (7), Biosphere (16), Cryosphere (17), Land Surface (59), Oceans (10), Solid Earth (1), Spectral/Engineering (52), and Terrestrial Hydrosphere (7).

The search results list three collections, each with a 'No image available' placeholder and an 'NRT' icon:

- MODIS/Aqua Near Real Time (NRT) Aerosol 5-Min L2 Swath 10km**
MYD04_L2 v6NRT -
NASA/GSFC/EOS/ESDIS/LANCEMODIS
2015-12-06
ongoing | 1549 Granules
- MODIS/Aqua Near Real Time (NRT) Land Surface Temperature/Emissivity 5-Min L2 Swath 1km (C005)**
MYD11_L2 v5NRT -
NASA/GSFC/EOS/ESDIS/LANCEMODIS
2002-05-04
ongoing | 2823 Granules
- MODIS/Aqua Near Real Time (NRT) Snow Cover 5-Min L2**

On the right side of the interface, there is a map of the Middle East and surrounding regions, including Saudi Arabia, Iraq, Iran, and others. The map includes a scale bar at the bottom right showing 1000 km and 500 mi.



<https://worldview.earthdata.nasa.gov/>

Recommendations on Data Discoverability

1. Require all NASA programs producing NRT Earth observation data to register data in the CMR at the collection level
2. Systematic modeling products, such as GMAO products should add imagery to GIBS as appropriate
3. Develop a set of managed CMR metadata tags to i) distinguish low latency products from other products and ii) utilize keywords from NASA's Global Change Master Directory to identify application areas and facilitate searches by application area
4. Develop a process to evaluate applications products, value added low-latency products that use NASA data and non-NASA satellite data.
 - *Those that met this criteria should be added to CMR at the Collection level*

Recommendations on how to engage new missions

1. New missions should survey communities to determine the value of low latency products.
2. If NRT products would be useful, missions should conduct a latency trade study – to help determine cost / benefit.
3. ESD flight projects should add latency to Earth Venture solicitations and directed mission requirements.



Recommendation to form a Latency Working Group

To carry forward recommendations and conduct strategic engagement and planning

- engage with programs and be an advocacy group for the NRT data producers
- review the progress towards improved data discoverability and usability

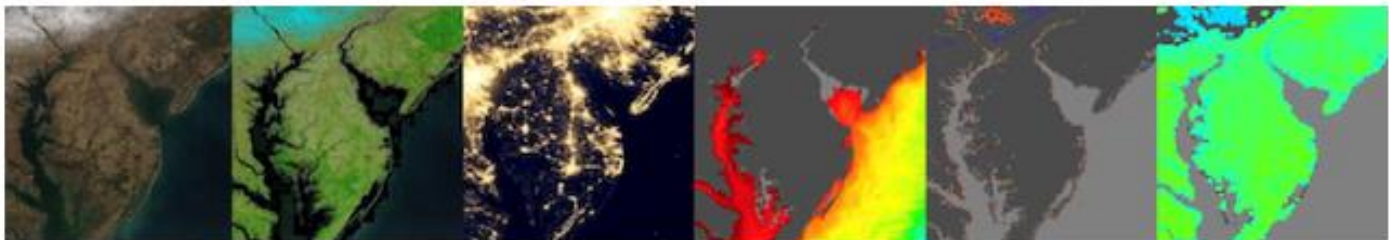


Next Steps

1. Latency Working Group
2. Register all systematic NRT NASA data in CMR *and by default into the Earthdata Search Client (and other data portals)*
3. Determine criteria and pathway for deciding how non-systematic if other products should be added in to CMR

To view the NRT Inventory: <http://tinyurl.com/nhmv9ky>

Contact? support@earthdata.nasa.gov with **NRT workshop** in the subject line



Thank you

To view the inventory of existing and planned/budgeted NASA/ESD
Near-Real-Time data sets go to: <http://tinyurl.com/nhmv9ky>

